

## Warm-up

Write the converse, inverse and contrapositive of the conditional below and state the truth value.

If I live in Pennsylvania, then I live in the USA.



Reminder: 2.1-2.3 Quiz on Friday.

## 2.3 Extension--Truth tables

Conditional statements can be written using symbolic notation.

If p, then q. p—hypothesis q—conclusion

$p \rightarrow q$  "if p, then q" or "p implies q"

## Symbolic Notation

Conditional  $p \rightarrow q$

Converse  $q \rightarrow p$

Inverse  $\sim p \rightarrow \sim q$

Contrapositive  $\sim q \rightarrow \sim p$

Biconditional  $p \leftrightarrow q$

## Specific Example:

If it is raining, then you have an umbrella. (T)

It's raining and you don't have an umbrella. (F)

It's not raining and you don't have an umbrella. (T)

It's not raining and you have an umbrella. (T)

The truth value of a statement is either true (T) or false (F).

A truth table shows the conditions when a conditional statement is true. It is only false when a true hypothesis produces a false conclusion.

Truth Table for Conditional

p	q	$p \rightarrow q$
T	T	T
T	F	F
F	T	T
F	F	T

p	q	$p \rightarrow q$	Converse $q \rightarrow p$	Inverse $\sim p \rightarrow \sim q$	Contr. $\sim q \rightarrow \sim p$
T	T	T	T	T	T
T	F	F	F	T	F
F	T	T	T	F	T
F	F	T	F	T	T

Examples:

Make a truth table for the logical statement.

$p \rightarrow \sim q$

p	q	$\sim q$	$p \rightarrow \sim q$
T	T	F	F
T	F	T	T
F	T	F	T
F	F	T	T

$$\sim(p \rightarrow q)$$

p	q	$p \rightarrow q$	$\sim(p \rightarrow q)$
T	T	T	F
T	F	F	T
F	T	T	F
F	F	T	F

Truth tables can also be made for conjunctions (and) and disjunctions (or).

"p and q" is true only when both p and q are true (symbolic  $p \wedge q$ )

"p or q" is false only when both p and q are false (symbolic  $p \vee q$ )

Conjunction		
p	q	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

Disjunction		
p	q	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

Ex:  $\sim p \vee q$

p	q	$\sim p$	$\sim p \vee q$
T	T	F	T
T	F	F	F
F	T	T	T
F	F	T	T

ex:  $(p \vee q) \wedge \sim r$

p	q	r	$p \vee q$	$\sim r$	$(p \vee q) \wedge \sim r$
T	T	T	T	F	F
T	F	T	T	F	F
T	T	F	T	T	T
T	F	F	T	T	T
F	T	T	T	F	F
F	F	T	F	F	F
F	T	F	T	T	T
F	F	F	F	T	F

HW

p95 #1-3, 7, 9, 10

1. **WRITING** Describe how to use symbolic notation to represent the contrapositive of a conditional statement.

**WRITING STATEMENTS** Use  $p$  and  $q$  to write the symbolic statement in words.

$p$ : Polygon  $ABCDE$  is equiangular and equilateral.

$q$ : Polygon  $ABCDE$  is a regular polygon.

2.  $p \rightarrow q$

3.  $\sim p$

**MAKING TRUTH TABLES** Make a truth table for the logical statement.

7.  $\sim p \rightarrow q$

9.  $\sim(q \rightarrow p)$

0. **LOGICAL EQUIVALENCE** The truth table shows that the conjunction " $p$  and  $q$ " is true only when  $p$  and  $q$  are both true. It also shows that the disjunction " $p$  or  $q$ " is false only when  $p$  and  $q$  are both false.

- a. Make a truth table for  $\sim(p \vee q)$ .  
b. Make a truth table for  $(\sim p \vee \sim q)$ .  
c. Show that  $\sim(p \vee q)$  and  $(\sim p \vee \sim q)$  are logically equivalent.

p	q	Conjunction $p$ and $q$	Disjunction $p$ or $q$
T	T	T	T
T	F	F	T
F	T	F	T
F	F	F	F